Bonneville Power Administration
Fish and Wildlife Program FY99 Proposal

Section 1. General administrative information

Comparative Survival Rate Study (Css) Of Hatchery Pit Tagged Chinook

Bonneville project number, if an ongoing project 8712702

Business name of agency, institution or organization requesting funding
Pacific States Marine Fisheries Commission

Business acronym (if appropriate) PSMFC

Proposal contact person or principal investigator:

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Subcontractors.

Organization	Mailing Address	City, ST Zip	Contact Name
ODFW	1410 L Ave	LaGrande, OR 97850	Mary Louise Keefe
WDFW	2018 Grand Ave.	Vancouver, WA 98661	Tom Cooney
IDFG	600 S Walnut St.	Boise, ID 83707	Bert Bowler
USFWS	9317 Highway 99	Vancouver, WA 98665	Walt Amberghetti
PSMFC	45 SE 82nd Dr.	Gladstone, OR 97027	Pam Kahut

NPPC Program Measure Number(s) which this project addresses.
3.6F.10, Sections 303, 403b, 1408.2.8

NMFS Biological Opinion Number(s) which this project addresses.
RPA Section 13 A, C and RPA Section 17

Other planning document references.
NMFS Biological Opinion RPA 13(a) & RPA 17

Subbasin.
Mainstem Snake and Columbia Rivers

Short description.
Adult and juvenile PIT tag recovery data are analyzed to compare survival estimates for transported fish of known origin, downriver stocks, wild and hatchery transported fish and fish handled and not handled at dams.

Section 2. Key words

Mark	Programmatic Categories	Mark	Activities	Mark	Project Types
X	Anadromous fish		Construction		Watershed
	Resident fish		O & M		Biodiversity/genetics
	Wildlife		Production	X	Population dynamics
	Oceans/estuaries		Research		Ecosystems
	Climate	X	Monitoring/eval.	+	Flow/survival
	Other	+	Resource mgmt		Fish disease
			Planning/admin.		Supplementation
			Enforcement		Wildlife habitat en-
			Acquisitions		hancement/restoration

Other keywords.
Smolt to adult return; transportation; PATH analysis

Section 3. Relationships to other Bonneville projects

Project #	Project title/description	Nature of relationship
9008000	PITAGIS	Critical Component
8712700	Smolt Monitoring	Critical Component
9602000	Hatchery PIT Tag Study	Marking for CSS (USFWS & IDFG)

Section 4. Objectives, tasks and schedules

Objectives and tasks

Obj 1,2,3	Objective	Task a,b,c	Task
1	Develop a long-term index of	a	Compute annual ratio of transport

	transport survival rate (smolt-to-adult) to inriver survival rate (smolt-to-adult for Snake River hatchery spring & summer chinook smolts.		survival rate to inriver survival rate
		b	Test if the annual ratio of transport survival rate to inriver survival rate (measured at LGR w/associated confidence intervall
		c	Evaluate inriver controls obtained from fish PIT tagged at the hatcheries have higher smolt-to-adult survival rates to LGR than inriver controls from migrating fish that were collected, handled, and PIT tagged at LGR
2	For Snake River basin hatcheries, develop a long-term index of survival rates from release of smolts at hatcheries to return of adults to hatcheries.	a	Partition survival rates (i) from hatchery (smolts) to Lower Granite Dam (smolts), (ii) from Lower Granite Dam (smolts) back to Lower Granite Dam (adults), and (iii) from Lower Granite Dam (adults) to the hatchery (adults).
		b	For the combined Snake River hatcheries, compute the annual survival rate of smolts transported at Lower Granite Dam to adult returns to the hatcheries.
		c	For the combined Snake River hatcheries, compute the annual survival rate of smolts migrating inriver to adult returns to the hatcheries.
		d	Explore the feasibility of increasing mark sizes to improve precision in the annual ratio of transport survival rate to inriver survival rate [Task 1(a)] measured back to the hatchery.
3	Compute and compare overall smolt-to-adult survival rates for selected upriver and downriver spring and summer chinook hatcheries.	a	Compute annual hatchery survival rates (adjusted for terminal harvest rates) using both CWT and PIT tags for selected upriver and downriver hatchery stocks. Compare survival rates of CWT

			and PIT tag estimates. Estimate survival rates (smolt-to-adult) fo
		b	Compute an annual ratio of downriver hatchery survival rate to upriver hatchery survival rate (all measured at the hatcheries and adjusted for terminal harvest) with associated confidence interval.
		c	Test if the annual ratio of downriver hatchery survival rate to upriver hatchery survival rate (all measured at the hatcheries) is greater than 2.0 with sufficient power to provide a high probability that the ratio is greater than 1.0.
		d	Test aggregately & individually the annual ratio of downriver hatchery survival rate to upriver hatcheries transported smolts survival rate is greater than 2.0 with sufficient power to privide a high probability that the ratio is greater than 1.0.
		e	Explore the feasibility of developing lower river wild index stocks (e.g., Warm Springs, John Day, and Klickitat rivers) to measure smolt-to-adult survival rates.
4	Begin a time series of smolt-to-adult survival rates for use in the PATH hypothesis testing process and in the regional long-term monitoring and evaluation program, which is under development.		
5	5. Evaluate growth patterns of transported and inriver migrating smolts, and of upriver and downriver stocks.	a	Collect and catalog scales from PIT tagged adults detected at Lower Granite Dam adult trap or at the upriver hatcheries.
		b	Coordinate with the downriver hatcheries to collect and catalog scales from CWT groups that are representative of the production

			lots from which the PIT tagged fish were taken.

Objective schedules and costs

Objective #	Start Date mm/yyyy	End Date mm/yyyy	Cost %
1	1/1999	12/1999	20.00%
2	1/1999	12/1999	20.00%
3	1/1999	12/1999	20.00%
4	1/1999	12/1999	20.00%
5	1/1999	12/1999	20.00%
			TOTAL 100.00%

Schedule constraints.
None known at this time.

Completion date.
Unknown

Section 5. Budget

FY99 budget by line item

Item	Note	FY99
Personnel		$103,399
Fringe benefits		$33,635
Supplies, materials, non-expendable property	Included with Operations & Maintenance	
Operations & maintenance		$44,044
Capital acquisitions or improvements (e.g. land, buildings, major equip.)	Detection Equipment	$300,000
PIT tags	# of tags: 223,650	$648,585
Travel		$8,495
Indirect costs		$47,971
Subcontracts		
Other	Oversight	$30,240
TOTAL		$1,216,369

Outyear costs

Outyear costs	FY2000	FY01	FY02	FY03
Total budget	$1,277,187	$1,341,046	$1,408,098	$1,478,503
O&M as % of total	4.00%	4.00%	4.00%	4.00%

Section 6. Abstract

The Comparative Survival Study is the fourth year of a long term PIT tag study to develop smolt-to-adult survival indices for spring and summer stream type chinook originating above Lower Granite Dam to evaluate smolt migration mitigation measures and actions (such as flow augmentation, spill, and transportation) for the recovery of listed salmon stocks. The objective of developing smolt-to-adult survival indices is consistent with the recommendations of the PATH (Plan for Analyzing and Testing Hypotheses) process being carried out by the regional, state, federal and tribal salmon managers with the Northwest Power Planning Council (NPPC). The PATH recommendations address the question, "can transportation of fish to below Bonneville Dam compensate for the effect of the hydro system on juvenile survival rates of the Snake River spring and summer chinook salmon during their downstream migration?" The PATH recommended research includes the following; 1) Estimate smolt-to-adult survival rate (SAR) for transported wild and hatchery stream type chinook, 2) Determine if SAR rates are significantly different from the interim SAR hydro goal, 3) Compare SARs of transported and downriver indicator stocks, 4) Estimate transport/control ratio and in-river survival concurrently over a number of years in order to span a range of environmental conditions.

Section 7. Project description

a. Technical and/or scientific background.

<u>NOTE: :</u> PLEASE SEE ATTACHMENT. THIS WORK STATEMENT IS REVIEWED ANNUALLY BY STATE, FEDERAL AND TRIBAL MANAGERS

This project incorporates the long term PIT tag marking and recovery of large numbers of groups of hatchery spring chinook juveniles. Hatchery groups from Lookingglass, Imnaha, McCall, Rapid River, Dworshak, Round Butte, Warm Springs, and Carson facilities. These PIT tag groups will be an important component of the regional Smolt Monitoring Program. Recovery of tag data in returning adults will be analyzed by the interagency Comparative Survival Study Oversight Committee. This analyses will result in smolt-to-adult survival estimates, comparison of wild and hatchery chinook SARs, evaluation of the transportation program and comparison of upriver and downriver SARs.

The project was developed through the regional PATH process, and is intended to address the question, " can transportation of fish to below Bonneville Dam compensate

for the effect of the hydrosystem on juvenile survival rates of Snake River spring and summer chinook salmon during their downstream migration?" The study design was developed by the Comparative Survival Study Oversight Committee. The committee includes the PATH representatives of the Washington Department of Fish and Wildlife, the Oregon Department of Fish and Wildlife, the Idaho Department of Fish and Wildlife, the Columbia River Intertribal Fish Commission and a representative of the Fish Passage Center. The study design has been reviewed by the Northwest Power Planning Council (NPPC) and Independent Scientific Advisory Board (ISAB) for 1997 and for 1998. The ISAB approved the study proposal and design in both reviews.

b. Proposal objectives.

1. Develop a long term index of transport survival rate (smolt-to-adult) to inriver survival rate (smolt-to-adult) for Snake River hatchery spring and summer chinook smolts.

2. For Snake River Basin hatcheries, develop a long-term index of survival rates from release of smolts at hatcheries to return of adults to hatcheries.

3. Compute and compare overall smolt-to-adult survival rates for selected upriver and downriver spring and summer chinook hatcheries.

4. Begin a time series of smolt-to-adult survival rates for use in the PATH hypothesis testing process and in the regional long-term monitoring and evaluation program which is under development.

5. Evaluate the growth patterns of transported and inriver migrating smolts and of upriver and downriver stocks.

c. Rationale and significance to Regional Programs.

This study is intended to begin to provide the basis for PATH analysis of long term alternatives for recovery of depressed listed and unlisted stocks of chinook and steelhead. The Region has committed to utilization of the PATH process in assessing alternative future recovery options. It will also provide downstream migration information for the regional Smolt Monitoring Program. This study will provide specific information which will provide the basis for long term mitigation decisions in the region, specifically the role of the smolt transportation program in recovery. Other PIT tag mark groups from other studies and projects will be included in this analysis where possible. The project reflects the reviews by the NPPC, Independent Scientific Advisory Board.

d. Project history

Component of basin-wide Smolt Monitoring Program, which is the basis of flows and passage management data submitted to the Fish Passage Center. Agencies and tribes funded under this contract are Idaho Department of Fish and Game (IDFG), Washington

Department of Fish and Wildlife (WDFW), Oregon Department of Fish and Wildlife (ODFW), Nez Perce Tribe and Chelan County PUD. (Prior to 1994 this contract also included the funding of the Fish Passage Center budget.)

IDFG has conducted smolt trapping activities for the SMP since 1985 on the Snake and Clearwater rivers near Lewiston, Idaho. Since 1993 IDFG has also operated a scoop trap on the lower Salmon River near Lewiston, Idaho. Since 1993 IDFG has also operated a scoop trap on the lower Salmon River near Whitebird, Idaho for the SMP. In 1996 the Snake and Salmon River trap operations will continue, while the Clearwater River trap operation will be replaced with an electroshocking and beach seining operation for the purpose of monitoring Gas Bubble Trauma in resident and migratory fish in the Clearwater River, as a result of spill at Dworshak Dam. The Snake and Salmon River trap operation provides data on outmigration timing and serves as a site for PIT tagging smolts from the Grande Ronde River drainage.

Smolt monitoring has been conducted by the Nez Perce tribe since 1991 under the Lower Snake River Compensation Plan (LSRCP) hatchery evaluations program, and in 1993 a joint effort was initiated with the Fish Passage Center (FPC) to better coordinate the ongoing outmigrant trapping operation with FPC project needs. Since 1996, SMP program funds have covered about two-thirds of the cost of the Imnaha River smolt monitoring activities. Each of the trap sites provides data on outmigration timing and biological characteristrics of outmigrating smolts, as well as data on migration rates and survival indices to downstream dams from the componenet of the run that is PIT tagged and reasleased from each trap.

An additional smolt monitoring site that is used to PIT tag outmigrating smolts is Rock Island Dam. A bypass trap has been operated at Powerhouse 2 by Chelan County PUD for the SMP since 1995. Migration timing past the dam, and gas trauma monitoring are also conducted at this site. SMP activities occur at each of the dams on the Snake and Columbia River conducting Corps Fish Transportation. Funds at these sites are split between the SMP and the Corps Fish Transportation and Oversight Program.

The Corps funds transportaation related activities, fish ladder hydraulic inspections and part of the daily fish sampling activities. The SMP funds part of the daily fish sampling activities and all of the activities related to gas bubble trauma monitoring, plus SMP funds cover data summarization and daily electronic data transmission. SMP responsibilities at these Corps fish transportation sites is split among state agencies. ODFW conducts the monitoring at Little Goose Dam, WDFW conducts the monitoring at Lower Granite, Lower Monumental and McNary dams. Monitoring at Lower Monumental and McNary dams was originally conducted by NMFS, but WDFW assumed responsibility for this activity in 1988 at Lower Granite Dam and in 1990 at McNary Dam. This resulted in an overall cost reduction due primarily to lower state administration overhead rates and partial time sharing of positions funded through other contracts.

At Lower Monumental Dam, WDFW conducted gatewell sampling from 1985 through 1991, and beginning in 1993, conducted smolt monitoring activities in the newly constructed collection/bypass system. In 1997 components of the CSS were added and in 1998 PIT tag costs were added for the first time.

The project began in 1996 and has had extensive regional review. The study is a coordinated regional effort under the auspices of a regional oversight committee and is closely tied to the Regional PATH process. The study has been conducted under two separate Bonneville Power Administration (BPA) project numbers #8712700 and #9602000. Review by the ISAB in 1997 has suggested consolidating the study under one project number which is being explored. Thus far, three years of juvenile marking have been completed. One year of jack returns and one year of adult return tags have been recovered. Preliminary analysis is being conducted.

The budget numbers for previous years for project #8712700 are as follows: 1987 – 800,332; 1988 – 921,430; 1989 – 1,022,337; 1990 – 989,545; 1991 – 1,221,103; 1992 – 1,278,046; 1993 – 1,396,393; 1994 – 682,927; 1995 – 1,139,870; 1996 – 1,696,000; 1997 – 1,299,914; 1998 – 1,696,000.

NOTE: As described above as Project History, the regionally reviewed smolt monitoring undergoes annual modifcation which makes a valid year to year direct comparison impossible.

e. Methods.

There are three test groups defined for the upriver hatchery stocks: Transport (T), Inriver 1 (I1), and Inriver 2 (I2).

- Group T consists of PIT tagged smolts diverted to the barge (or truck) at Lower Granite Dam.

- Group I1 consists of known PIT tagged smolts migrating inriver below Lower Granite Dam, because it includes only those fish that were detected at one or more dams and returned to river. Group I1 is a subset of Group I2. Since it consists of known survivors to the downstream dams, it may have a higher adult return rate than Group I2. Similarity in adult return rates between Group I1 and I2 will be evaluated.

- Group I2 consists of the estimated number of PIT tagged smolts alive in the Lower Granite Dam tailrace that will then migrate inriver below Lower Granite Dam. The number of smolts in Group I2 is the sum of detected smolts re-released at Lower Granite Dam and the estimated number of undetected PIT tagged smolts alive in the Lower Granite Dam tailrace. This estimated number (defined as $RN_{1@2}$) will be computed using the Jolly-Seber methodology (Burnham *et al.*, 1987) as follows (letting Cohort 1 represent the undetected fish at Lower Granite Dam and Cohort 2 the detected and re-released fish at Lower Granite Dam):

  $RN_{1@2} = z_2 @ \{R_2 / r_2\}$ where $z_2 = 3\ m_{1\,j}$ with m fish at j^{th} dam for Cohort
  R_2 = number of detected PIT tagged fish re-released to river at Lower Granite Dam.

  In determining the size of Group I2, satisfaction of the assumptions of Jolly-Seber methodology is required. In particular, this requires that the subsequent survivability and collectability of PIT tagged fish are the same between the two cohorts through the reach of reservoirs and dams below Lower Granite Dam, which will be tested.

Returning adults are assigned to Group T and Group I1 based on the fact that the smolts were detected at the dams entering into one of those two groups, whereas returning adults are assigned to Group I2 based only on the fact that those fish are known not to have been transported. By the very nature of being observed as a returning adult, these PIT tagged fish are known to have been part of the group of fish alive in the tailrace of Lower Granite Dam.

In years when NMFS conducts their transportation studies, survival rates of Group I1 and Group I2 (aggregate of all upriver hatcheries) would be compared to the survival rates of the aggregate of inriver migrants collected, marked, and re-released as control groups by NMFS at Lower Granite Dam.

The partitioning of survival rates in Objective 2 will require estimating the following. The survival rate for smolts from hatchery to Lower Granite Dam will be computed for each hatchery group using the Jolly-Seber methodology. A composite average survival rate from hatchery to Lower Granite Dam will be computed by weighting by the hatchery production numbers. The survival rate from Lower Granite (smolts) to Lower Granite (adults) will be generated in the tasks of Objective 1, using the aforementioned groups T1, I1, and I2. These survival rates will be based on the aggregate of upriver hatcheries within each group. The survival rates from Lower Granite Dam back to the individual hatchery for adults will be computed as a ratio of detections at the hatchery to detections at Lower Granite Dam for the groups T1, I1, and I2. Adult returns to the hatcheries from T, I1 and I2 will be adjusted by estimated terminal harvest rates (if any). An anticipated benefit from this task is the ability to estimate confidence intervals and look at the feasibility of designing future experiments to achieve the desired significance and power in hypothesis testing.

For Objective 3 the selected upriver hatcheries will include Rapid River, McCall, Dworshak, and Lookingglass hatcheries for analysis with PIT tagged and CWT adult returns. The downriver hatcheries include Carson and Round Butte hatcheries for analysis with PIT tagged and CWT adult returns. Adult returns from Cowlitz Hatchery PIT tag releases in 1996 and 1997 will be compared with onsite CWT adult returns, and future SAR's for this hatchery will be based on CWT data (no future PIT tag releases for this study). Adult returns will be adjusted by estimated terminal harvest rates. Because jacks make up a lower proportion of the upriver total return compared to the downriver total return, the comparison between smolt-to-adult returns to the upriver and downriver hatcheries will be made both with and without jacks included. Mini-jack returns to any hatchery will be excluded from the total smolt-to-adult returns.

Sample Size Requirements:

Sample size requirements vary among objectives, desired levels of precision (significance), the difference one is trying to measure, the power of the tests to detect a true difference of that magnitude, and the expected smolt-to-adult return rates of the different groups.

Target number of returning adults:

Objective 1: The target number of adult recoveries for Transport (T) and Inriver (I1 and I2) groups is 86 adult fish. This number of adult recoveries from each group will be sufficient to determine if the annual ratio of transport survival rates to inriver survival rates is greater than 1.5 with approximately 90% power to show that the ratio is greater than 1.0 at a significance level of a=0.05 (Snedecor and Cochran 1967.

Objective 2: The target adult recovery levels are the same as those for Objective 1.

Objective 3: The target number is 26 adult recoveries from each upriver (U) and downriver (D) hatchery to determine if the ratio of D/U is greater than 2.0 with approximately 90% power to show that the ratio is greater than 1.0 at a significance level of a=0.05 (Snedecor and Cochran 1967).

Number of smolts to PIT tag to meet target number of returning adults:
The number of smolts required for Objective 1 is based on smolt-to-adult return rates estimated from NMFS transportation studies in past years. The minimum (1989) smolt-to-adult return rate (SAR) was 0.2% and the average across 7 years of study was approximately 0.4%. Under low flow and no spill conditions, we assume the lowest SAR and under high flow and moderate-to-high spill conditions we assume the average SAR. The number of smolts arriving at Lower Granite Dam that need to be assigned to the transport and inriver groups in order to arrive at the target goal of 86 adult returns is 43,000 transport and 64,500 inriver fish under the low flow, no spill scenario and 21,500 transport and 32,250 inriver fish under the high flow, moderate-to-high spill scenario.

The number of smolts required for Objective 3 is based on smolt-to-adult return rates to Rapid River, McCall, and Round Butte hatcheries for the 1979-1987 brood years. The average >79-87 SAR measured back to McCall and Rapid River hatcheries was 0.82% (summer chinook stock) and 0.28% (spring chinook stock), respectively. The average >79-86 SAR measured back to Round Butte Hatchery was about 1.1%. Past wild chinook SAR estimates for Warms Springs River have ranged between 2-6%. The smaller SAR of 0.28% would require approximately 9,300 PIT tagged fish in transport to achieve the target goal of 26 adult returns. Under these historic SAR levels, the downstream stocks would need at least 2,400 hatchery fish and 1,300 wild fish to achieve the minimum of 26 adult returns.

f. Facilities and equipment.

PIT tag detection facilities and PIT tag separation by code facilities are required at major mainstem projects. The PITAGIS data system is required. Juvenile PIT tag detection facilities are required for Rapid River Hatchery for volitional releaseof juvenile salmon. Adult detection facilities are required at Round Butte Hatchery, Warm Springs Hatchery, Carson Hatchery, Imnaha Hatchery and completed as needed at other facilities.

Provide support and assistance at Lower Granite Trapping facility as part of adult recapture evaluation for survival study.

g. References.

Boregerson, L.A. 1991. A determination of the hatchery and wild ratios and selected life history characteristics from scales of transported and non-transported groups of spring chinook and steelhead in the Snake River. Oregon Department of Fish and Wildlife, Annual Progress Report, Portland.

Boregerson, L.A. 1992. Life history studies of spring and summer chinook salmon and steelhead from the Snake River using scale analysis. Oregon Department of Fish and Wildlife, Annual Progress Report, Portland.

Burnham, K.P., D.R. Anderson, G.C. White, C. Brownie, and K.H. Pollock. 1987. Design and analysis methods for fish survival experiments based on release-recapture. American Fisheries Society Monograph 5. ISSN 0362-1715. Bethesda, Maryland. 437 p.

Snedecor, G.W. and W. G. Cochran. 1967. Statistical methods. Sixth edition. Iowa State University Press. Ames, Iowa. 593 p.

Section 8. Relationships to other projects

The CSS project is a Critical Component of the Smolt Monitoring Program. The CSS project relates to all other projects utilizing PIT tags in studies of juvenile salmon migration through the Columbia and the Snake rivers. The CSS is coordinated with all mainstem passage studies and activities and the operation of PIT tag detection facilities. The PITAGIS data system is a critical component of this project.

Section 9. Key personnel

Oversight Committee:
Charlie Petrosky, Idaho Department of Fish and Game
Tom Berggren, Fish Passage Center
Howard Schaller, Oregon Department of Fish and Wildlife
Olaf Langness, Washington Department of Fish and Wildlife
Earl Weber, Columbia River Intertribal Fish Commission
Marking:
Rodney Duke, Idaho Department of Fish and Game
Walt Ambrogetti, Dave Wills, US Fish and Wildlife Service
Mary Louise Keefe, Oregon Department of Fish and Wildlife
Larry Basham, Fish Passage Center

Section 10. Information/technology transfer

Data from this project will be maintained in the PITAGIS data system in the same manner as all PIT tag information is maintained. Analysis by the Oversight Committee will be provided through the PATH process and presented as determined by the Oversight Committee. Juvenile passage data and analysis resulting from this project will be presented and distributed regionwide through the Fish Passage Center, Smolt Monitoring Program annual report.